

# **AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)**



for  
**STRUCTURAL**  
**(3E3X1)**

**MODULE 15**  
**CONCRETE STRUCTURES**

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CONCRETE STRUCTURES

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Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

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**Notice.** This AFQTP is NOT intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

**AIR FORCE QUALIFICATION TRAINING PACKAGES**  
**for**  
**STRUCTURAL**  
**(3E3X1)**

**INTRODUCTION**

*Before starting this AFQTP*, refer to and read the “Trainee/Trainer Guide” located on the AFCESA Web site <http://www.afcesa.af.mil/>

*AFQTPs are mandatory and must be completed* to fulfill task knowledge requirements on core and diamond tasks for upgrade training. *It is important for the trainer and trainee to understand* that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

*AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.*

**MANDATORY minimum upgrade requirements:**

***Core task:***

AFQTP completion  
Hands-on certification

***Diamond task:***

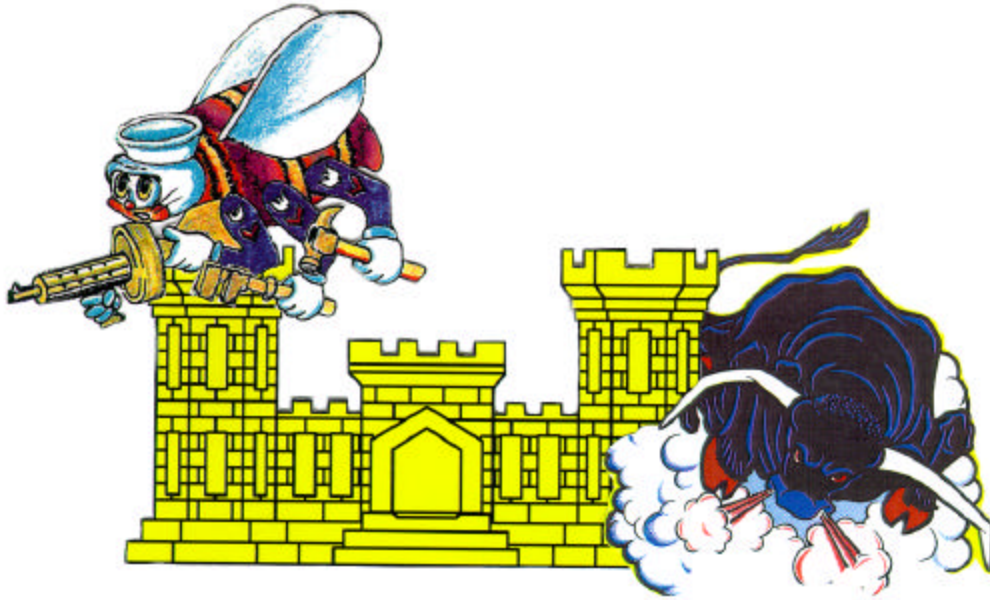
AFQTP completion  
CerTest completion (80% minimum to pass)

***Note:*** *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

***Put this package to use.*** Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Structures Career Field Manager at the address below.

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## CONCRETE REINFORCEMENT

### MODULE 15

### AFQTP UNIT 2

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### INSTALL REINFORCING STEEL (15.2.1.)

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**INSTALL REINFORCING STEEL*****Task Training Guide***

<b>STS Reference Number/Title:</b>	15.2.1. Install reinforcing steel
<b>Training References:</b>	<ul style="list-style-type: none"><li>• CDC 3E351C Vol. 2</li><li>• NAVEDTRA 12521.</li><li>• MODERN MASONRY by Clois E. Kicklighter.</li></ul>
<b>Prerequisites:</b>	<ul style="list-style-type: none"><li>• Possess as a minimum, a 3E331 AFSC.</li></ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"><li>• Rebar cutter</li><li>• Wire cutters</li><li>• Flexible wire</li><li>• Wire snips</li></ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"><li>• Trainee should be able to install reinforced steel in concrete for a required job.</li></ul>
<b>Samples of Behavior:</b>	<ul style="list-style-type: none"><li>• Trainee should be able know the different types reinforced steel and how to install them.</li></ul>

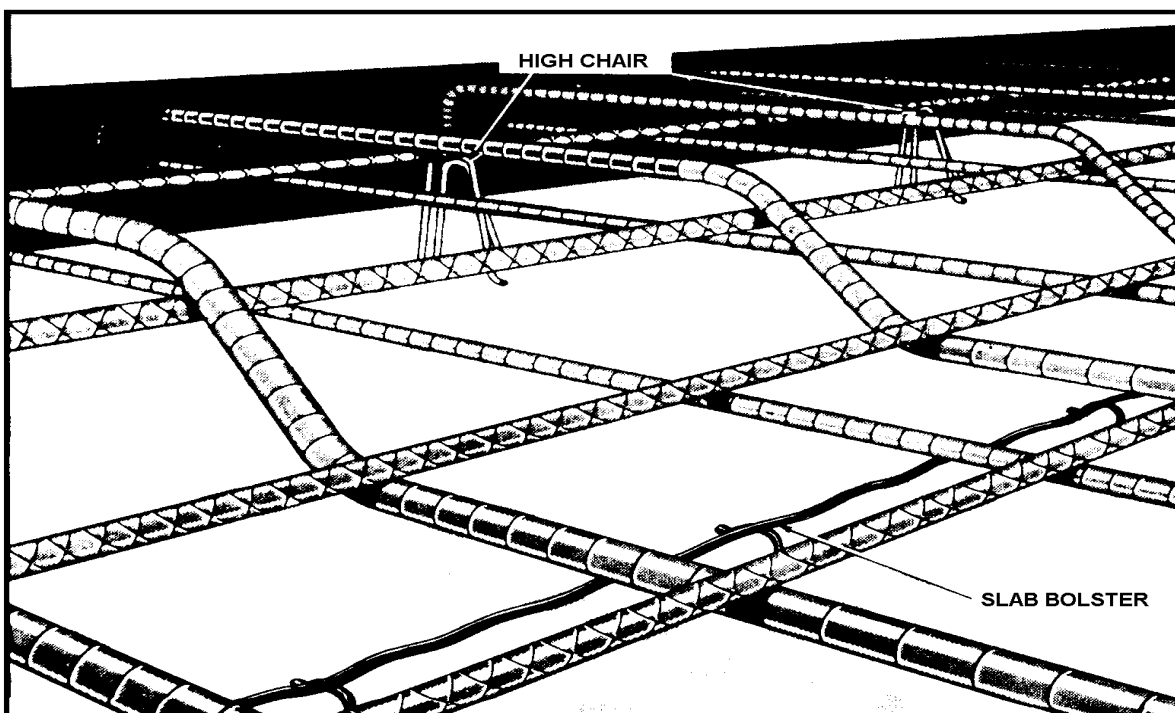
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## INSTALL REINFORCING STEEL

**Background:** Concrete is strong under compression, but relatively weak under tension. The reverse is true for steel. Because of its tensile strength, steel is considered the best material for reinforcing concrete.

### Slabs.

- The reinforced steel rods are placed parallel with the girders and perpendicular to the beams. The rebar should be tied together before the concrete is poured. The height of the slab bolster and high chairs depends on the job specification. The rebar should be at least 3 inches off the ground for exterior slabs, and 3/4 inches off the ground for interior slabs, (Figure 1).



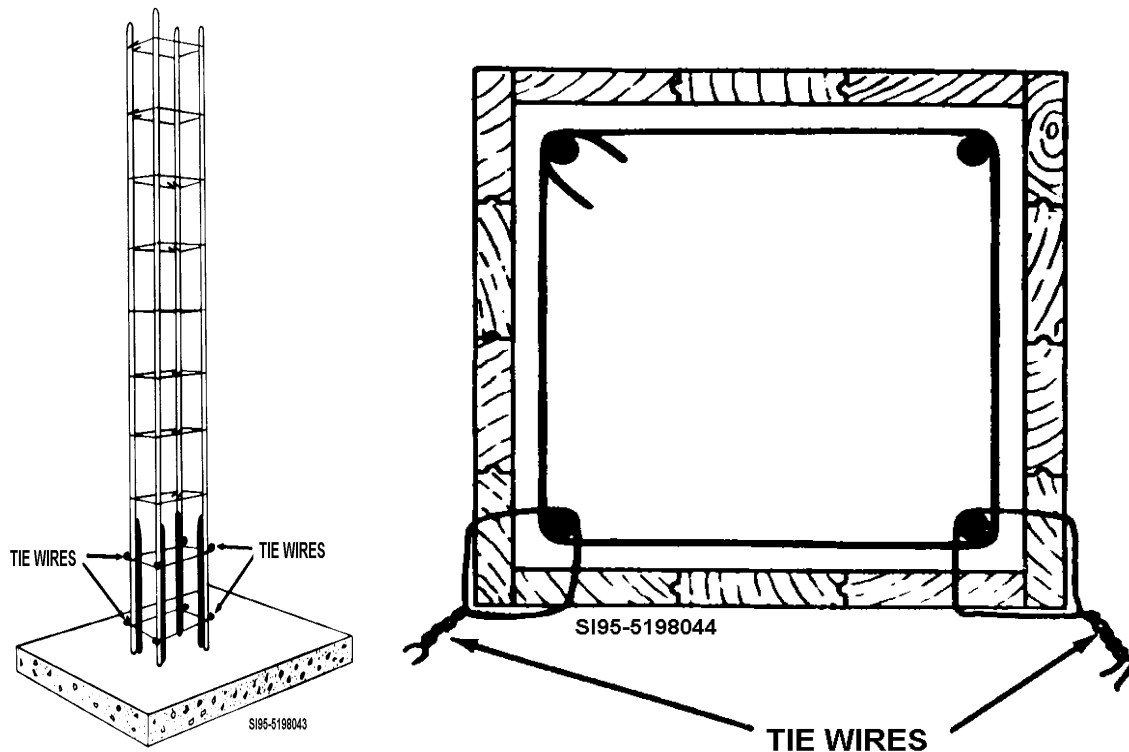
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Figure 1, Reinforced Steel Rods.

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### Columns.

- Steel for column ties can be assembled into cages by laying the vertical bars for one side of the column horizontally across a couple of sawhorses. The proper number of ties is slipped over the bars, the remaining number vertical bars are added, and then the ties are spaced out as required by the placing plans. After the form is raised the rebar is lowered into the form. Then it is tied to the form at 5-foot intervals, (Figure 2).



**Figure 2, Steel for Columns Ties Assembled in cages**

### Walls.

- Rebar is placed in footings very much as it is placed in floor slabs. Stones, rather than steel supports, may be used to support the steel at the proper distance above the subgrade. Stub up the rebar at least 3 feet above the footer, then after you lay the block you can attach more rebar as you work up. When overlapping rebar it should be 30 times the bar diameter. After the rebar is attached to the stubbed up sections, fill the cells of the block with cement.

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**Review Questions**  
**for**  
**Install Reinforcing Steel**

Question	Answer
1. Concrete is strong under compression, but not under tension.	a. True b. False
2. The rebar should be how high off the ground in an exterior slab?	a. 8 inches b. 1 inch c. At least 3 inches d. 3/4 inches
3. When building a cage for a column, how often should you tie the rebar to the form after its installed?	a. Every 2 feet b. Every 5 feet c. At every joint d. Never required
4. What should you use as spacers for rebar in the subgrade?	a. Crushed stone b. Stones c. Block d. Dirt

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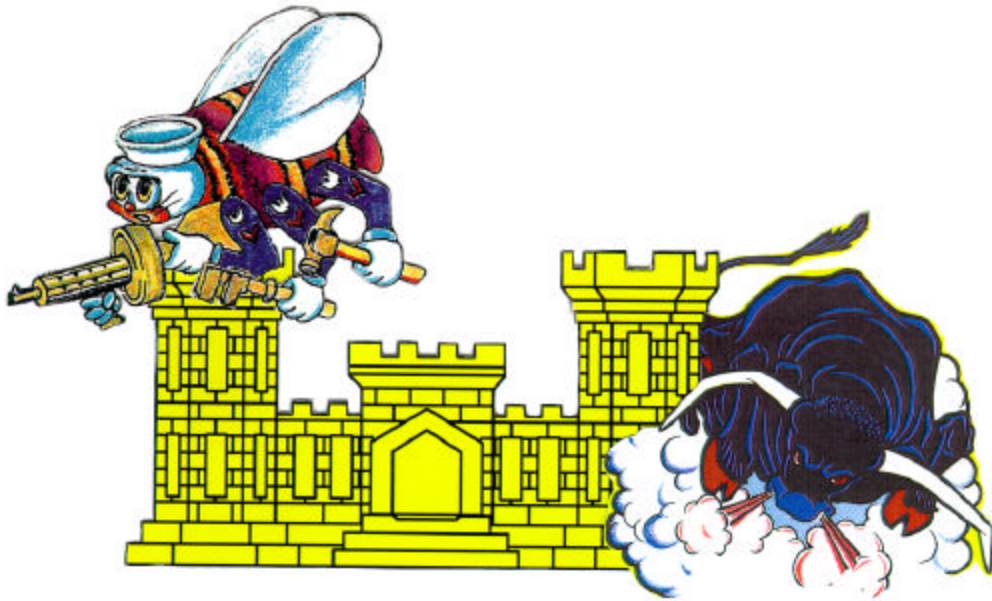


**INSTALL REINFORCING STEEL**

<b>Performance Checklist</b>		
<b>Step</b>	<b>Yes</b>	<b>No</b>
1. Did the trainee get the proper spacing for the rebar on the slab for an exterior slab?		
2. Did the trainee use enough ties on the rebar to hold it together?		
3. Did the trainee construct the cage together properly for a column?		
4. Did the trainee stub up the rebar high enough when laying block walls?		

**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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## CONSTRUCT FORMS

MODULE 15

AFQTP UNIT 3

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SLABS (15.3.4.)

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## SLABS

### *Task Training Guide*

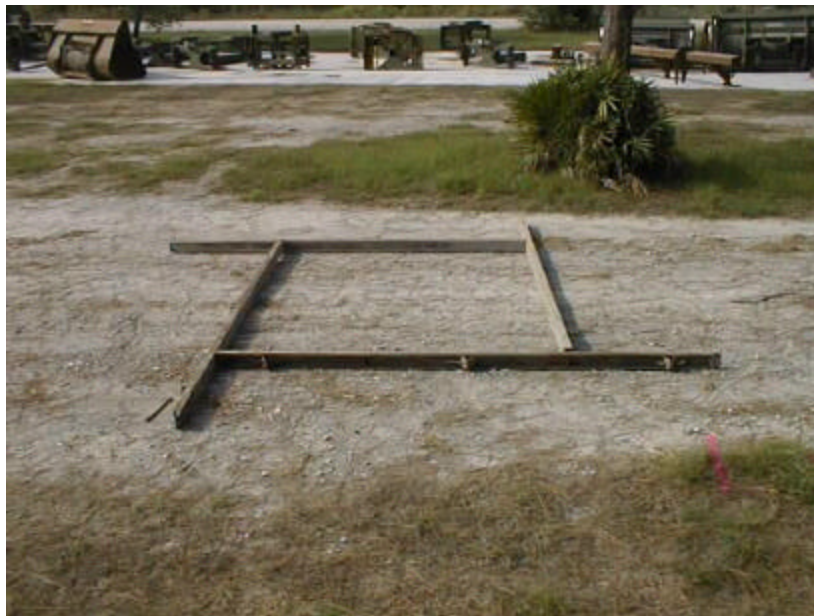
<b>CFETP Reference Number:</b>	15.3.4. Slabs
<b>Training References:</b>	<ul style="list-style-type: none"><li>• CDC 3E351C Vol. 2</li><li>• TR: NAVEDTRA 12520</li><li>• MODERN MASONRY by Clois E. Kicklighter</li></ul>
<b>Prerequisites</b>	<ul style="list-style-type: none"><li>• Possess as a minimum, a 3E331 AFSC.</li></ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"><li>• 3E3X1 Consolidated Tool Kit (CTK)</li></ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"><li>• Trainee should know how to construct forms for a concrete slab.</li></ul>
<b>Samples of Behavior:</b>	<ul style="list-style-type: none"><li>• Trainee should be able to demonstrate how to construct concrete forms for slabs, using wood and steel.</li></ul>

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## SLABS

**Background:** Slab foundations take several forms. The slab can be used with other elements such as walls, piers, and footings. One type of slab can be supported by the footings, or piers driven into the ground and the slab connects to the pier using rebar. This is called a **STRUCTURALLY SUPPORTED** slab. A second type is laid directly on top of the ground. These are referred to as **GROUND SUPPORTED**. Some slabs, particularly in warmer climates, are constructed in one continuous pour. This is called **MONOLITHIC** concrete or a monolithic pour. This type of construction is appropriate over soils with low bearing capacity.

In this unit we will discuss different types of forms used to form your more common types of slabs that you may encounter in your Air Force career. Metal forms are used where the construction is duplicated at more than one location. They are initially more expensive than wood forms, but may be more economical if they can be reused repeatedly. Originally, all prefabricated metal forms were made of steel. These forms were heavy and hard to handle. Currently, aluminum forms, which are lightweight and easier to handle, are replacing steel. Metal forms come in many different sizes and shapes for doing different types of concrete work such as column, walls, bridges, and slabs. The standard concrete pavement metal form is very suitable for forming either square or rectangle floor slabs, Figure 1.



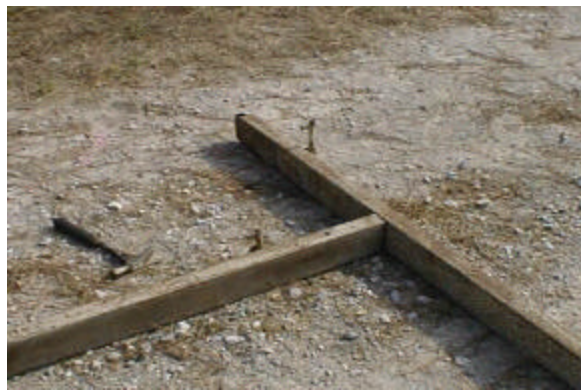
**Figure 1, Metal Forms Set Up For A Square Floor Slab.**

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There are other metal forms that are very similar to your standard wood sizes, 2 x 4, 2 x 6, 2 x 8, etc. Most of them are 10 foot in length, which make them easier to install. A majority of your metal forms are all anchored the same way using a metal stake. The stake is inserted through the backside of the form and the stake is driven just below the top surface of the form. The stake is then held into position with a steel wedge that is part of the form itself, Figure 2. You must be sure to level and square the form prior to driving the stake all the way down to the top of the form. When constructing a slab that is 10' x 10' the metal forms should work out with no overlapping of the corners or falling short of the corners. When constructing a slab foundation that is more or less then a multiple of 10' you may have to over run the corners, Figure 3. If it is not possible to over run the corners then fill in with appropriate size lumber.



**Figure 2, Metal Stake and Wedge for Form.**



**Figure 3, Metal Form Over Run.**

Wood forms can also be used for slab foundations, Figure 4. Lumber is readily available at your local lumberyard in many different sizes. To determine what size lumber you need, measure from where the finished slab is supposed to be, down to the ground. Most of the time you will use 2" x 4"s for driveways, patios, and sidewalks. 1 x 4"s can also be used to curve a sidewalk or driveway. For foundations that are used in buildings you will probably use larger material such as 2" x 6"s on up to 2" x 12"s. Regardless of which material you use, you will have to level and brace your forms in order to support the concrete until it hardens.

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There is no rule for how many stakes or braces you should use. A common practice is a stake placed every 2' to 4' depending on the type of material being used and condition of the soil. If in doubt always add more stakes or braces. Once the concrete has been placed into forms and the forms start to give way, it is very difficult if not impossible to push the form back into place.



**Figure 4, Wood Stakes with Wood Form**

Regardless of what type of form you decide to use, you will have to use several tools to construct and install them. The most popular tools to use are going to be a circular saw, handsaw, hammer, sledgehammer, shovel, 4' level and a line level.

If the slab is rather large, it is best to have the Engineer Technicians assist in erecting batter boards for true building lines. Use 2" x 4" pieces for the stakes and 1" x 6", or wider, pieces for the ledgers. Locate the batter boards at least 4 feet away from the corners created by the building lines, Figure 5. For smaller jobs you may have to install the forms with out the use of batter boards.

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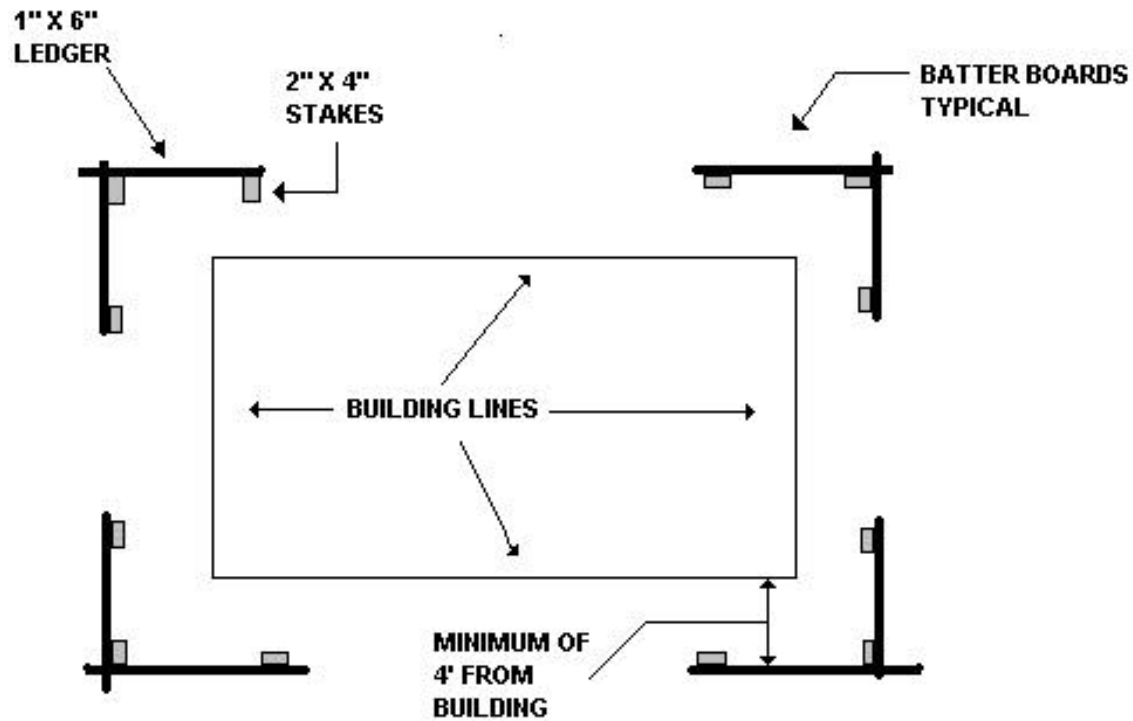


Figure 5, Typical Batter Board Layout.

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### Review Questions for Slabs

Question	Answer
1. Batter boards are used on _____.	<ul style="list-style-type: none"> <li>a. small slabs</li> <li>b. large slabs</li> <li>c. concrete slabs</li> <li>d. All the above</li> </ul>
2. What is the standard length for steel forms?	<ul style="list-style-type: none"> <li>a. 20 feet</li> <li>b. 10 feet</li> <li>c. All the above</li> <li>d. None of the above</li> </ul>
3. What is the standard length for wood forms?	<ul style="list-style-type: none"> <li>a. 20 feet</li> <li>b. 10 feet</li> <li>c. There is not a standard length for wood forms</li> <li>d. None of the above</li> </ul>
4. What type of lumber should be used for creating a curve on a driveway?	<ul style="list-style-type: none"> <li>a. 2" x 4" x 16'</li> <li>b. 2" x 6" x 16'</li> <li>c. 1" x 4" x 8'</li> <li>d. 4" x 4" x 16'</li> </ul>
5. What type of slab is poured in one continuous pour?	<ul style="list-style-type: none"> <li>a. Batter Supported</li> <li>b. Monolithic</li> <li>c. Ground Supported</li> <li>d. Structurally Supported</li> </ul>

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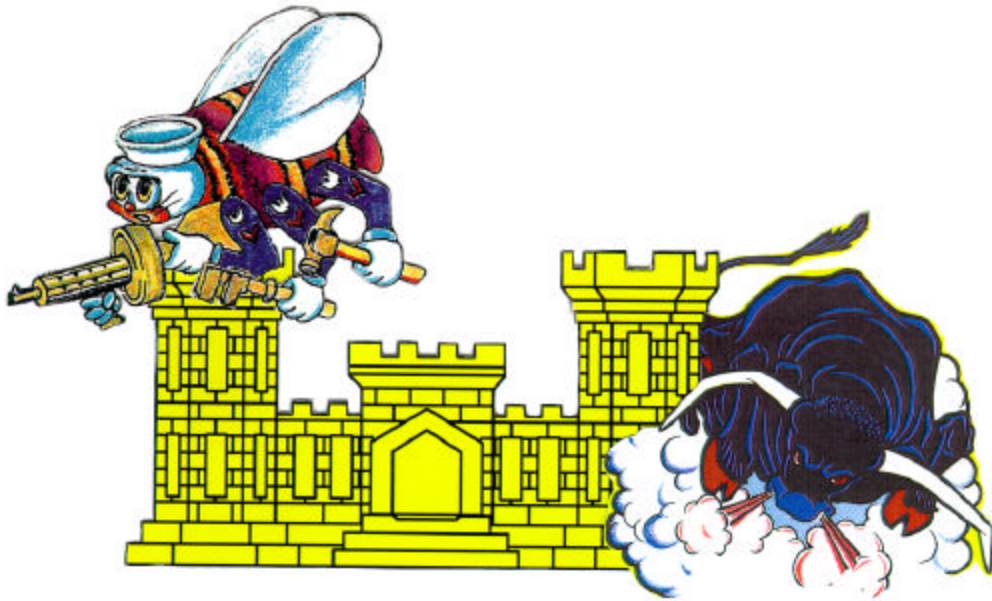


**SLABS**

<b>Performance Checklist</b>		
<b>Step</b>	<b>Yes</b>	<b>No</b>
1. Can the trainee explain the difference between metal and wood forms?		
2. Did the trainee use the correct tools?		
3. Can the trainee state the correct size lumber to use in building a 4" pad?		
4. Can the trainee determine how far apart to place stakes for the forms?		

**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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## CONCRETE STRUCTURES

MODULE 15

AFQTP UNIT 5

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### INSTALL FORMS (15.5.)

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## INSTALL FORMS

### *Task Training Guide*

<b>STS Reference Number/Title:</b>	15.5. Install Forms
<b>Training References:</b>	<ul style="list-style-type: none"><li>• CDC 3E351C Vol. 2</li><li>• MODERN MASONRY by Clois E. Kicklighter</li></ul>
<b>Prerequisites:</b>	<ul style="list-style-type: none"><li>• Possess as a minimum, a 3E331 AFSC</li></ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"><li>• 5 lb. Sledgehammer</li><li>• String line</li><li>• Claw hammer</li><li>• 4' level</li><li>• Skill saw</li><li>• Duplex nails</li></ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"><li>• Trainee should know how to install forms for a slab</li></ul>
<b>Samples of Behavior:</b>	<ul style="list-style-type: none"><li>• Trainee should know be able to demonstrate how to install forms for a slab using both wood and metal forms</li></ul>

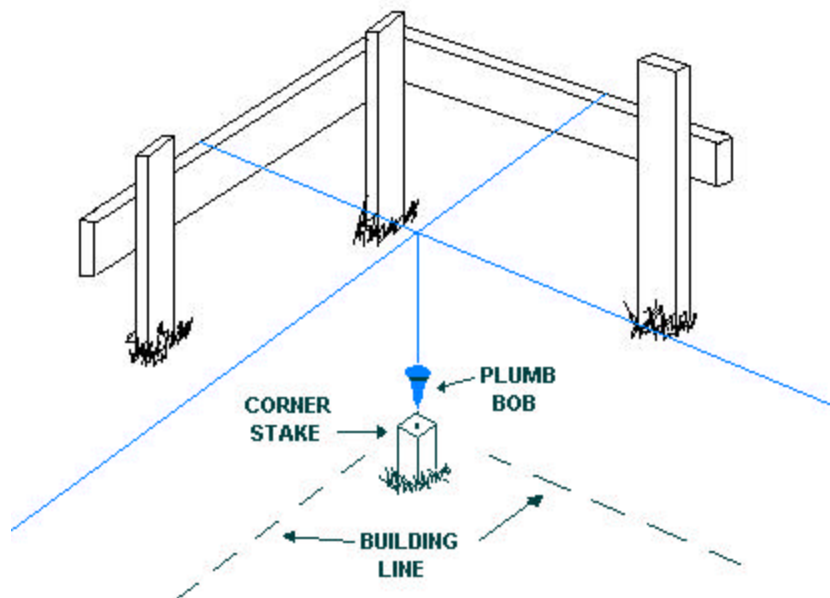
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## INSTALL FORMS

**Background:** The portion of a structure that extends above the ground level is called the superstructure. The portion that extends below the ground level is called the substructure. The parts of the substructure that distribute building loads to the ground are called foundations. In this unit we will discuss different types of forms used to form your more common types of slabs that you may encounter in your Air Force career.

Preparation of the building site may require grading and/or removal of trees. Grading may be needed before the building lines are laid out. This may require the placement of grade level stakes. It will usually require the use of a transit or level. Again, this is a job that an Engineer Technician will assist with. If the grass and under brush is not removed from the building site eventually the grass will die after the concrete has been placed and cured. The dead grass will then leave a void under the new concrete slab.

There are two methods of installing forms, depending on what size slab is being constructed. For smaller slabs there may be no requirement for batter boards, Figure 1, but for your larger slabs, it is advisable to have the Engineering Technicians come out to the job site and assist in installing the batter boards. This is best done with an instrument called a level or a transit. If batter boards are used to install the forms, simply follow the string lines that are set up on the batter boards for the outside and top edge of your slab. Always double-check the string lines to ensure they are square before staking down all the forms and securing them prior to the concrete being poured.



**Figure 1, Typical Batter Board Layout.**

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The second method of installing the forms is by use of a 4' level, string line and some grade stakes, Figure 2. Again, this is for some smaller slabs that you may encounter. The procedure here is the same for the procedure that you will use for batter boards as far as how the forms are installed. But instead of batter boards you can use some 2" x 2" lumber that are cut into stakes. Approximately one foot from the outside edge of your building line, drive the stake in line with where you are going to install your first corner. It is important that you start at the highest corner of your excavation if it is not level. If you were not to start at the highest corner, the other end of your slab could possibly be below the ground level and this would cause a problem of water getting on to your slab, Figure 3.

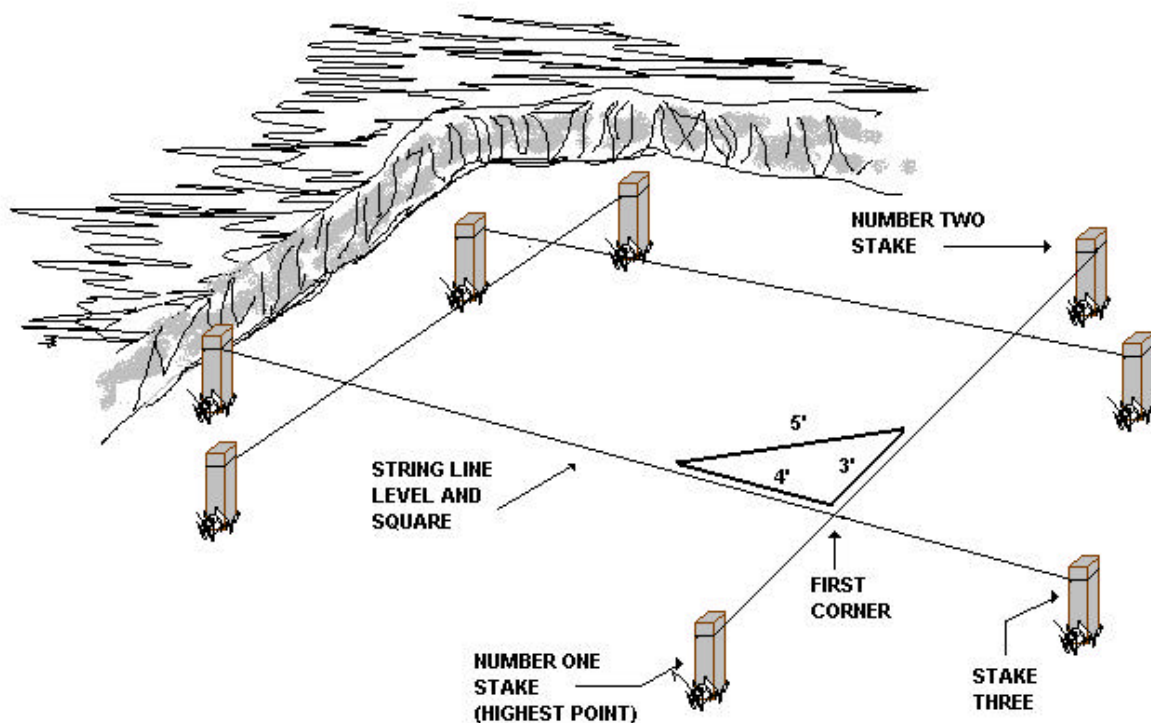
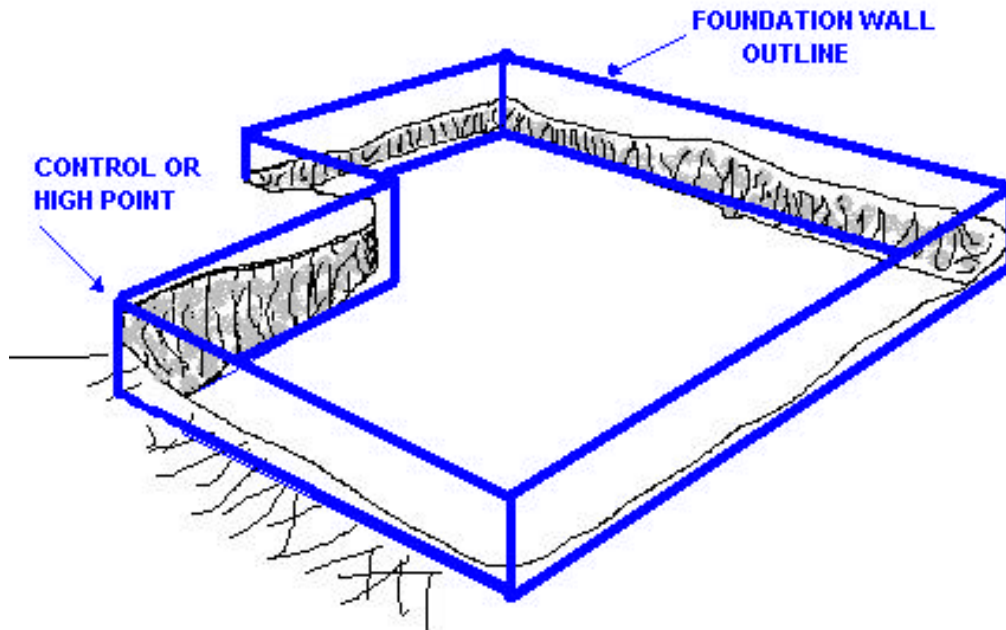


Figure 2, Stake Layout Method.

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**Figure 3, Excavation and Building Layout.**

Once you have established this first stake, you can now start driving the remaining corner stakes. Measure out to the second corner and install the second stake. You will use this as your base point for all remaining stakes. Run a string line between the two stakes. Use a line level to set the second stake level with the first. The string line will represent the top of the finished slab. To set the third corner, run another string line level at the correct measurement, and square the line with your base point line. You can use the 3, 4, 5 method of squaring. Once you have established the third corner and it is square and level, use the same procedure to find the fourth corner. Figure 1.

At this point you should have the building lines marked out with the string lines and it should be level and square all the way around. After all corners are square, place your form under the string line. Let the form barely touch the string line. At this point you can begin staking the forms every 2-4' or as much as necessary to level as you go. You can always go back and install additional stakes for support prior to the concrete being placed. Every once in awhile, double-check your string line to ensure you are still square and level. When using metal or wood forms, try to use duplex nails as much as possible. This will allow for easy disassembly.

Once the forms are installed and all stakes have been installed, it is advisable to back fill around the outside edge of the forms. When using metal forms, concrete has a tendency of gathering in the outside portion of the form, and will be difficult to clean out. By back filling with some loose fill material, the concrete will not fill up this portion of the form. Back filling also assists in strengthening the forms as well.

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The next step prior to pouring the concrete is to put some type of oil onto the form surface that will be in contact with the concrete. This will give you a better finish and also assist in cleaning the forms once removed.

### **Installing the forms.**

*To perform the task, follow these steps.*

- **Step 1: Prepare the site by clearing any grass or trees.**
  - **Step 2: Set your first corner.**
    - Starting at the highest corner of the slab, set your first corner stake.
    - Measure out to the second corner and set another stake.
    - Run a string line between the two stakes and use a line level to set the second stake level with the first. The string line will represent the top of the finished slab.
    - Establish the third corner by running another string line.
    - Level and square off of the first sting line.
    - Repeat this step to find the fourth corner.
  - **Step 3: Place your forms under the string line.**
    - After all corners have been established, place your forms under the string line barely touching the string itself.
    - If your forms are too long, you can over run the corner of slabs, Figure 3.
    - If you are using wood forms, simply cut the form to length.
- Step 4: Stake the forms.**
- Stake the forms down to the ground every 2-4' or as much as necessary.
  - Keep the forms level as you continue to stake them down.
  - Try to use duplex nails when available.
- **Step 5: Level and square.**
    - After all the forms are in place and secured, check to see if they are all level and square.
    - Back fill forms to keep clean and before placing any concrete in them.
    - Make sure you oil them to make it easier to take them apart and clean them.

**SAFETY:**

**USE VEGETABLE OIL INSTEAD OF MOTOR OIL OR DIESEL FUEL. VEGETABLE OIL IS ENVIRONMENTALLY SAFE.**

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### Review Questions for Install Forms

Question	Answer
1. Why do you want to remove any grass and under bush prior to pouring a new pad?	<ul style="list-style-type: none"> <li>a. Easier installation of forms</li> <li>b. The grass will grow up into the pad</li> <li>c. The grass will create a void in the concrete</li> <li>d. The grass will remove all the water from the concrete</li> </ul>
2. What is the determining factor of installing forms with the use of batter boards or grade stakes?	<ul style="list-style-type: none"> <li>a. Location of new pad</li> <li>b. Size of the new pad</li> <li>c. Thickness of the new pad</li> <li>d. If the pour will be monolithic</li> </ul>
3. What instrument can be used to assist the Engineer technician in setting batter boards?	<ul style="list-style-type: none"> <li>a. Line Level</li> <li>b. Shovel</li> <li>c. Transit</li> <li>d. Plumb bob</li> </ul>
4. When first starting to form for a pad, what corner should you start in to get your baseline?	<ul style="list-style-type: none"> <li>a. Start with the highest corner</li> <li>b. Start with the lowest corner</li> <li>c. Do not start at the corner, start in the middle of the pad</li> <li>d. All the above</li> </ul>
5. What type of nails should you use for installing forms?	<ul style="list-style-type: none"> <li>a. Box</li> <li>b. Finish</li> <li>c. Form</li> <li>d. Duplex</li> </ul>

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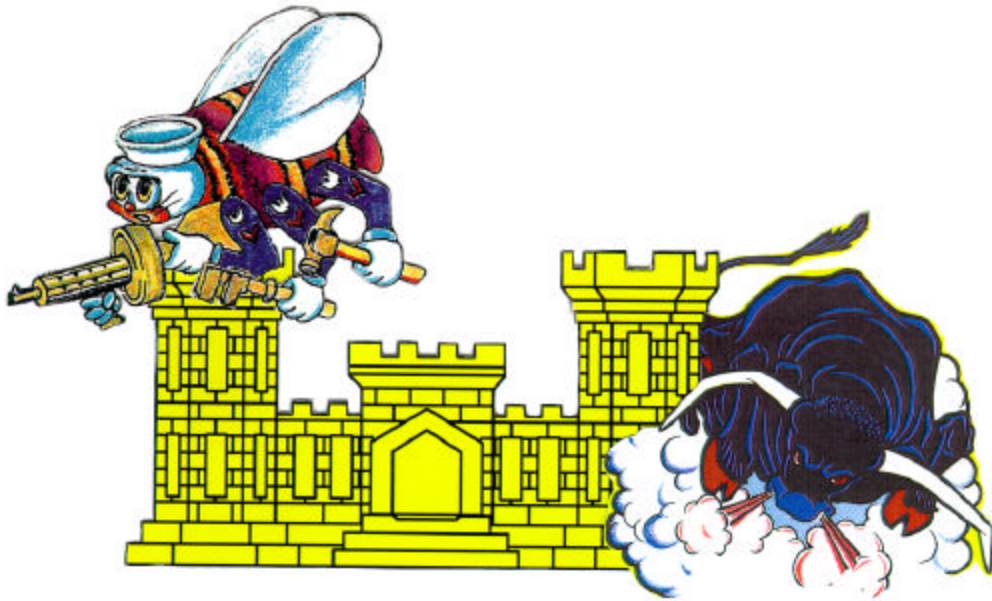


**INSTALL FORMS**

<b>Performance Checklist</b>		
<b>Step</b>	<b>Yes</b>	<b>No</b>
1. Did trainee remove grass and under bush prior to installing forms?		
2. Did trainee install batter boards and/or grade stakes for the form correctly?		
3. Did the trainee start at the highest corner of the pad when they installed the forms?		
4. Did the trainee install the correct amount of stakes?		
5. Can the trainee state the best type of oil to use on forms and why it is used?		

**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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## CONCRETE STRUCTURES

MODULE 15

AFQTP UNIT 9

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### PLACE CONCRETE IN FORMS (15.9.)

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**PLACE CONCRETE IN FORMS*****Task Training Guide***

<b>STS Reference Number/Title:</b>	15.9. Place concrete in forms
<b>Training References:</b>	<ul style="list-style-type: none"><li>• CDC 3E351C Vol. 2</li><li>• TR: NAVEDTRA 12520</li><li>• MODERN MASONRY by Clois E. Kicklighter</li></ul>
<b>Prerequisites:</b>	<ul style="list-style-type: none"><li>• Possess as a minimum, a 3E331 AFSC.</li></ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"><li>• Shovel</li><li>• Concrete rake</li><li>• Spade tool</li><li>• Mechanical vibrator</li><li>• Wheel barrow</li></ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"><li>• Trainee should know steps required to place concrete in forms.</li></ul>
<b>Samples of Behavior:</b>	<ul style="list-style-type: none"><li>• Trainee should be able to demonstrate the procedures to place concrete in forms.</li></ul>

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## PLACE CONCRETE IN FORMS

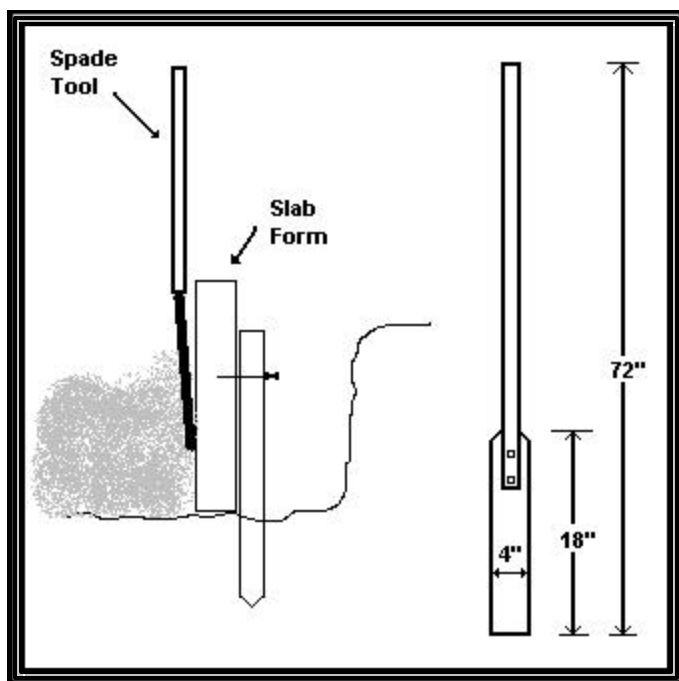
**Background:** After the forms are set, the reinforcement materials are in place (rebar, wire mesh), and the correct mix has been determined, you're ready to place the concrete into the forms. After you place it into the form, you must consolidate it, finish it, and let it cure properly. Usually most of the concrete can be poured directly from the ready-mix truck into the forms. To move the concrete to other areas not accessible to the truck, a wheelbarrow or bucket is generally used.

Place concrete near to where it will rest. Never allow it to run or be worked over long distances. To do so could cause segregation. (This is a condition in which large aggregates get separated from cement paste and smaller aggregates.) Place concrete in forms promptly after mixing.

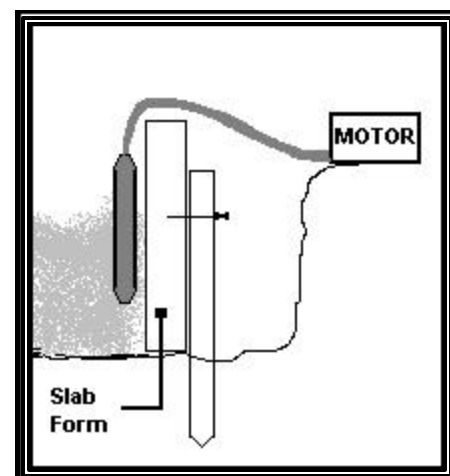
In general, concrete for walls should be placed in the forms in horizontal layers of uniform thickness not exceeding 6 to 12 inches. As the concrete is placed, spade or vibrate it enough to compact it thoroughly. This produces a dense mass.

Working the concrete next to the form tends to produce a smooth surface. It prevents honeycombing along the form faces. A spade or thin board may be used for this purpose, Figure 1. Large aggregates are forced away from the forms and any air trapped along the form face is released. Mechanical vibrators are effective in consolidating concrete, Figure 2.

However, vibrators create added pressure on the forms. This factor must be considered in the form design. The vibrator should not be held in one location long enough to draw a pool of cement paste from the surrounding concrete.



**Figure 1, Spade Tool Used to Work Concrete on Sides of Form**



**Figure 2, Mechanical Vibrator used to work concrete.**

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Consolidating eliminates rock pockets and large air bubbles and brings enough fine material to the surface to produce the desired finish. In the process of consolidation, carefully work the concrete around the reinforcing steel to assure proper embedding of the steel in the concrete. In consolidating, try to avoid displacing the reinforcing steel, because the strength of the concrete depends on its proper location.

*To perform the tasks, follow these steps.*

- **Step 1: Double-check all the forms.**
  - Ensure they are well anchored in place and they are still level and square.
- **Step 2: Ensure the wire mesh or reinforcement bar is installed and tied correctly.**

This is where you will get all the strength required for a good pad.

  - It is a good idea to put down a moisture vapor under the mesh or rebar. This will allow the concrete to cure more slowly by not allowing the water from the concrete to be absorbed into the ground. A good vapor barrier is 15-mil plastic over the entire ground surface.
- **Step 3: Plan ahead on where the concrete truck will deliver the concrete.**
  - Always start placing the concrete at the far end of the form away from your concrete source working towards the source. This way you do not have to work over the freshly poured concrete.
  - Be prepared if you have to stop pouring for a long period of time, roughen the top of the poured concrete so that when you resume, the new concrete will have a good surface to adhere to.
- **Step 4: As the concrete is being poured.**
  - Ensure you work it enough to get the desired finish. You can use the spade tool described previous or a mechanical vibrator.
- **Step 5: Prepare to finish concrete. (Covered in the next module)**

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## Review Questions for Place Concrete in Forms

Question	Answer
1. What should be accomplished prior to the concrete being placed into the form?	<ul style="list-style-type: none"> <li>a. Rebar is in place</li> <li>b. Forms are square and level</li> <li>c. Forms are well secured</li> <li>d. All of the above</li> </ul>
2. Why do you NOT want to work concrete over long distances?	<ul style="list-style-type: none"> <li>a. To do so will cause segregation</li> <li>b. It will cause a smooth finish</li> <li>c. It will not cure</li> <li>d. There will be too much cement in the mix</li> </ul>
3. Concrete for walls should be placed in _____ layers of uniform thickness not exceeding 6 to 12 inches.	<ul style="list-style-type: none"> <li>a. vertical</li> <li>b. plumb</li> <li>c. horizontal</li> <li>d. diagonal</li> </ul>
4. What can be placed down prior to the mesh or rebar to keep the ground from absorbing all the water out of the concrete?	<ul style="list-style-type: none"> <li>a. 15-mil plastic</li> <li>b. Plywood</li> <li>c. Sheet metal</li> <li>d. Base course</li> </ul>
5. What sort of tool(s) can be used to consolidate the concrete to provide a smooth surface?	<ul style="list-style-type: none"> <li>a. Spade Tool</li> <li>b. Shovel</li> <li>c. Mechanical vibrator</li> <li>d. Both a. and c.</li> </ul>

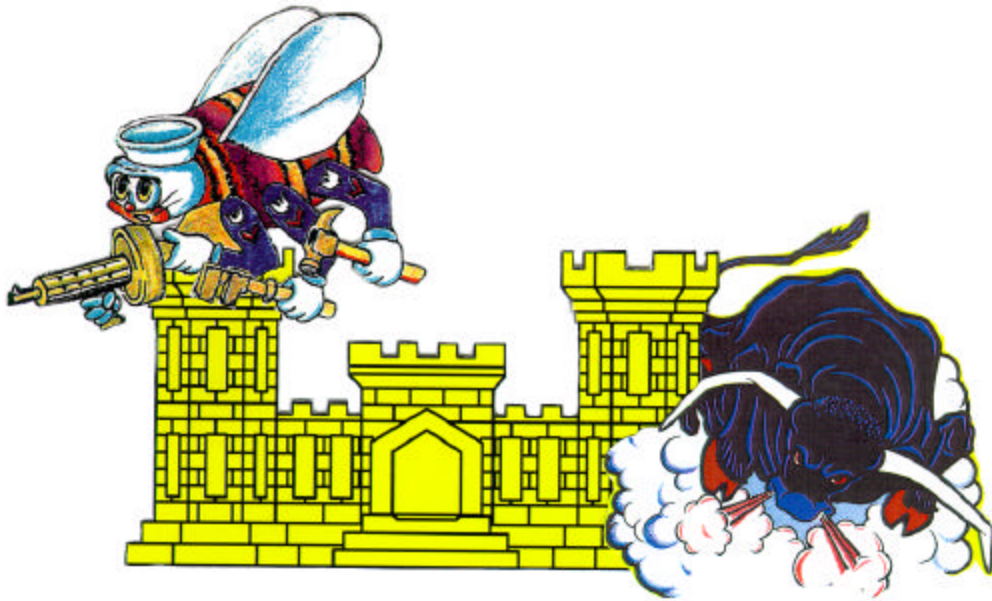
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**PLACE CONCRETE IN FORMS**

<b>Performance Checklist</b>		
<b>Step</b>	<b>Yes</b>	<b>No</b>
1. Did the trainee check the stakes prior to the concrete being placed into the forms?		
2. Did the trainee plan the delivery of the concrete and how it will be transported into the forms?		
3. Can trainee explain why a moisture barrier is used prior to placing the rebar?		
4. Can the trainee list the tools used to consolidate the concrete?		

**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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## CONCRETE STRUCTURES

**MODULE 15**

**AFQTP UNIT 12**

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### FINISH CONCRETE (15.12.)

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## FINISH CONCRETE

### *Task Training Guide*

<b>STS Reference Number/Title:</b>	15.12. Finish concrete
<b>Training References:</b>	<ul style="list-style-type: none"><li>• CDC 3E351C Vol. 2.</li><li>• TR: NAVEDTRA 12520.</li><li>• MODERN MASONRY by Clois E. Kicklighter</li></ul>
<b>Prerequisites:</b>	<ul style="list-style-type: none"><li>• Possess as a minimum, a 3E331 AFSC.</li></ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"><li>• Screed board</li><li>• Jitterbug</li><li>• Float</li><li>• Edger</li><li>• Jointer</li><li>• Steel trowel</li><li>• Plastic</li></ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"><li>• Trainee should know the steps and procedures of finishing and curing concrete.</li></ul>
<b>Samples of Behavior:</b>	<ul style="list-style-type: none"><li>• Trainee should be able to demonstrate the steps and procedures of finishing and curing concrete</li></ul>

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## FINISH CONCRETE

**Background:** Finishing the concrete that has been poured is a very important part of for the curing process. This will help in the overall appearance of the concrete after it has set up. If the proper attention has not been taken during the finishing process then the proper repairs must be made to repair the concrete surface. In this unit we will discuss how to finish concrete.

**Screeding.** The first step in finishing concrete is the screeding of all the excess concrete to a level elevation. Screeding may be the only type of finish required. This process strikes off all of the excess concrete to bring the concrete surface to the proper elevation. This process is accomplished by moving a 2" by 4" or 2" by 6" board with a straightedge back and forth in a sawing motion. The straightedge rests on top of the wood forms or metal forms and is used as a guide. With each motion move the straightedge forward a short distance. Keep a small amount of concrete ahead of the straightedge to fill low spots. Make sure this process is completed in a slow motion. After the concrete has been struck, then a jitterbug may be used. The course aggregate is tamped slightly below the surface of the concrete. See Figure 1.

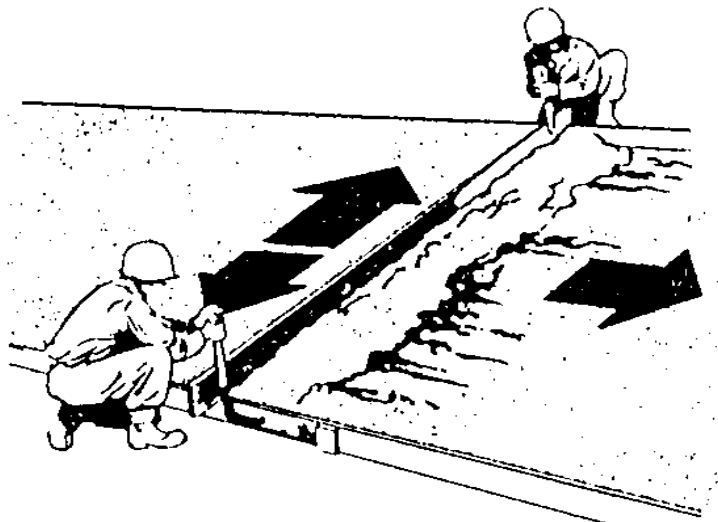
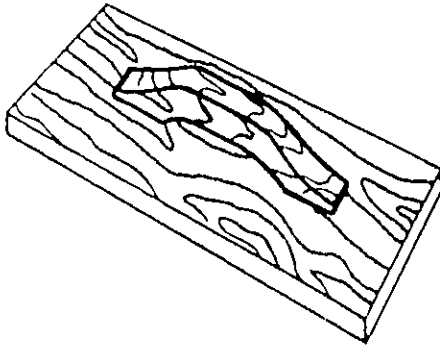


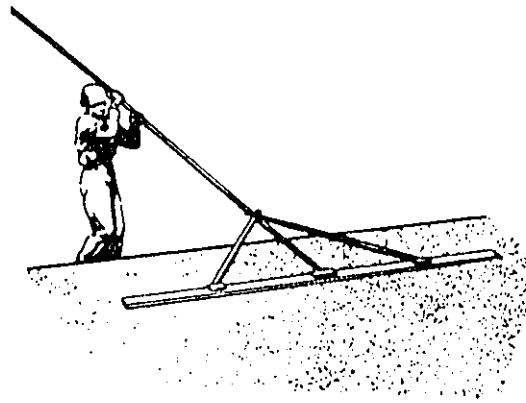
Figure 1, Screeding Concrete

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**Floating.** The next process is to float the concrete. This process gives the surface a smooth texture. Wood or aluminum magnesium floats are the tools used in the floating process, Figures 2 and 3. Floating embeds the aggregate particles beneath the surface, removes slight imperfections, and compacts the concrete at the surface. Do not over work the concrete while it is still plastic. This brings too much water to the surface. This will cause the concrete to scale in the future (wear out).

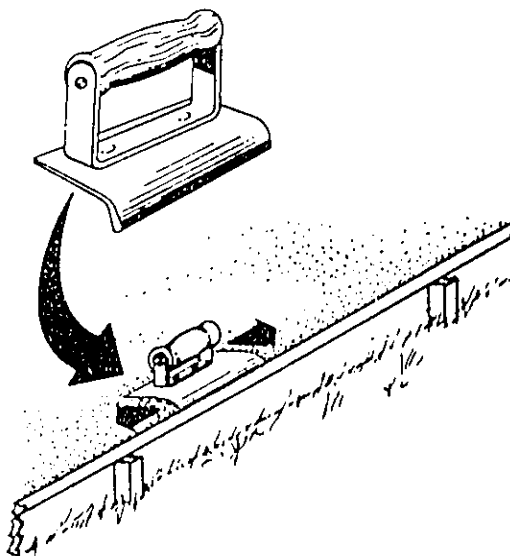


**Figure 2, Wood Float.**

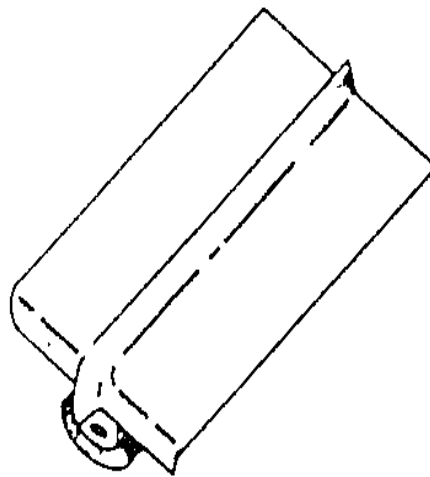


**Figure 3, Long-handled Float.**

**Edging and Jointing.** The next process will include edging and jointing before the concrete gets too stiff. Edging should be completed soon after the floating takes place. Edging gives a rounded look and prevents the concrete from chipping, Figure 4. Jointing should also be accomplished soon after the floating. This helps the concrete to not crack or chip. A jointer tool is used to accomplish this task, Figure 5.



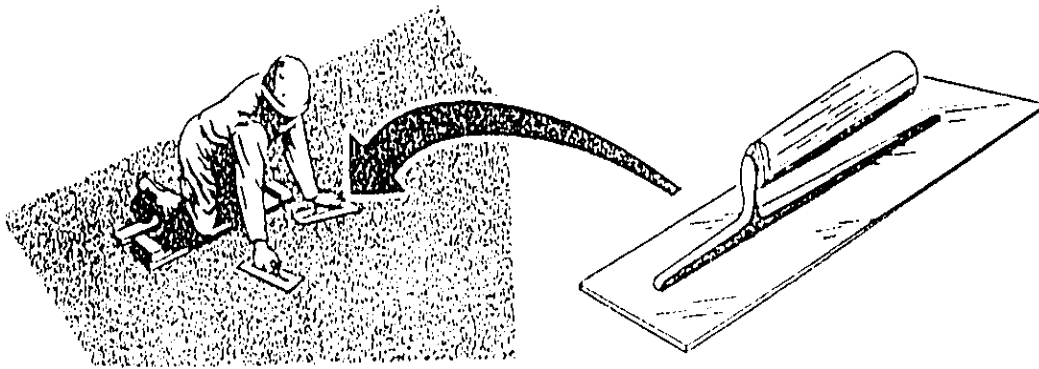
**Figure 4, Edging Concrete**



**Figure 5, Jointer**

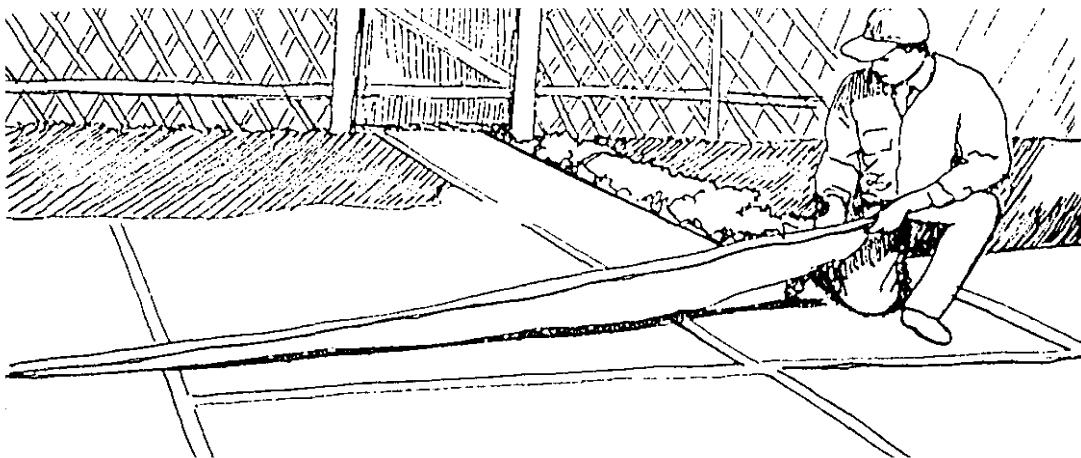
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**Surfacing.** Is the last process and can be completed by using many different methods. By using a Carborundum stone a uniform and attractive surface can be achieved. A broom finish can be accomplished by using a broom on the surface. Using a machine power trowel that rotates in a circular motion can complete smooth finish. This type of finish is called a machine finish. Keep the concrete damp as you work. You can get a smooth, dense surface by using a steel trowel (as in fig. 6.) Troweling should only be accomplished when the surface has no standing water. The circular motion should be used while using a trowel. Be careful not to work with the concrete too soon because it could cause crazing (breaking into pieces) and lack of durability. If not worked with soon enough then the surface may become too difficult to work with. There is a second troweling that takes place when the mortar will not adhere to the trowel any longer. The trowel should be tilted at a slight angle as the trowel passes over the surface and is completed in a sweeping motion. See Figure 6.



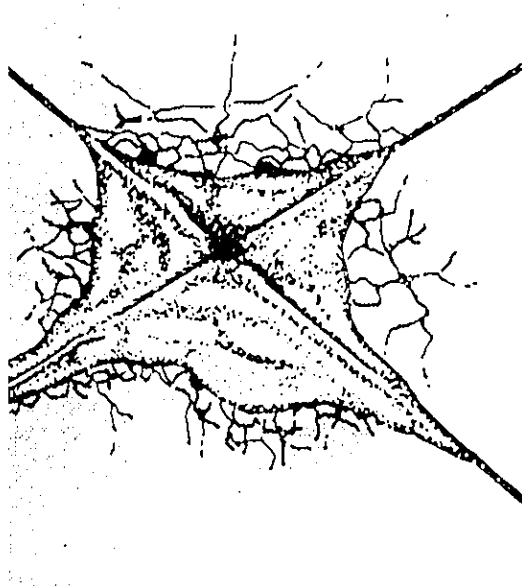
**Figure 6, Troweling Cement**

**Curing.** Covering with plastic, wet burlap, or keeping the concrete cool by spraying water over it then starts the curing process. The important thing to remember is that the concrete needs to stay at a temperature of 73 degrees Fahrenheit. This should give the surface a nice smooth appearance after the curing process, Figure 7. Over-finishing concrete could cause scaling, Figure 8.



**Figure 7, Curing the Cement.**

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**Figure 8, Scaling due to Over-finishing.**

This unit should give the information necessary to help in the concrete finish process. As one would expect there are several ways to accomplish concrete finishing. This unit has enough information to get started on a concrete finishing job.

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**Review Questions  
for  
Finish Concrete**

Question	Answer
1. What is the first step in finishing the concrete after it has been placed?	a. Edging b. Cover with Plastic c. Screeding to a level elevation d. Bull floating
2. What does the step “floating” do to the concrete?	a. Embeds the aggregate beneath the surface b. Allows the concrete to break at that point c. Keeps all the water beneath the surface d. Causes the concrete to scale
3. When should the edging of the concrete take place?	a. Before the concrete gets too stiff b. After the floating takes place c. Before the floating takes place d. Both a. and b.
4. What is used to get a machine finish on the concrete?	a. Power trowel b. Jointer c. Broom d. Carborundum Stone
5. What can be used to cover the concrete to assist in the curing process?	a. Plastic b. Wet burlap c. Water d. All of the above

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**FINISH CONCRETE**

<b>Performance Checklist</b>		
<b>Step</b>	<b>Yes</b>	<b>No</b>
1. Did the trainee screed the concrete to level the surface?		
2. Did the trainee know when to begin the floating process?		
3. Did the trainee begin the edging and jointing process too soon or too late?		
4. Did the trainee begin surfacing the concrete at the correct time?		
5. Can the trainee explain the difference between the final finish and machine finish of the concrete?		
6. Did the trainee cover the finished concrete with plastic, water, or wet burlap?		

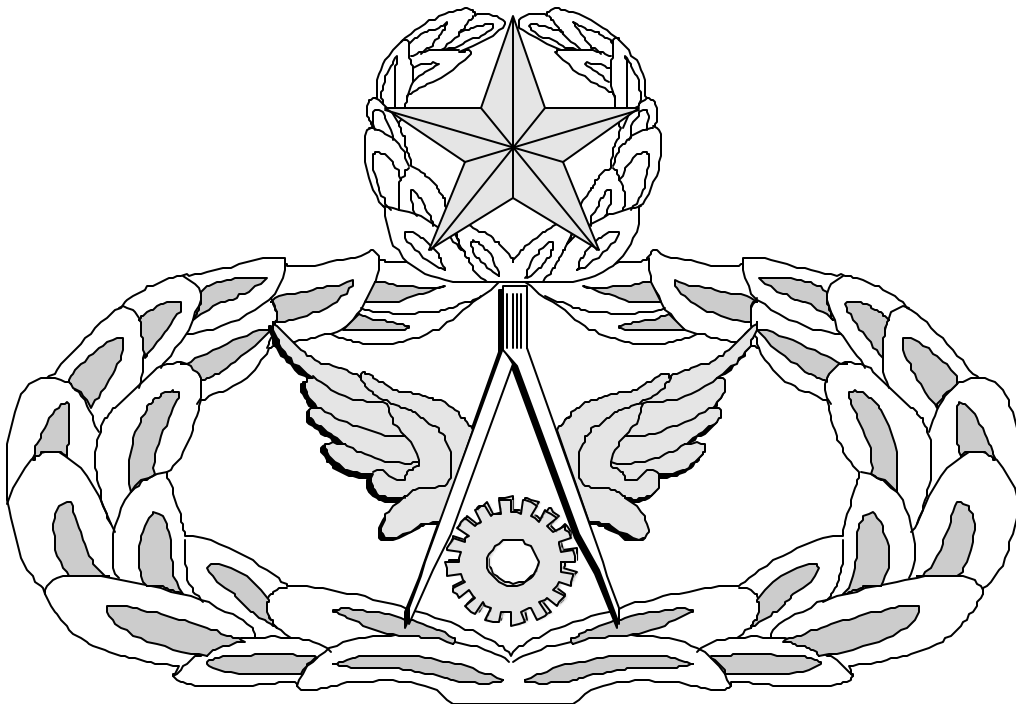
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# Air Force Civil Engineer

## QUALIFICATION TRAINING PACKAGE (QTP)

### REVIEW ANSWER KEY



for  
STRUCTURAL

(3E3X1)

MODULE 15

CONCRETE STRUCTURES

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**Key-1**



**INSTALL REINFORCING STEEL****(3E3X1-15.2.1.)**

<b>Question</b>	<b>Answer</b>
1. Concrete is strong under compression, but not under tension.	a. True
2. The rebar should be how high off the ground in an exterior slab?	b. At least 3 inches
3. When you build a cage for a column, how often should you tie the rebar to the form after its installed?	b. Every 5 foot
4. What should you use as spacers for rebar in the subgrade?	b. Stones

**Slabs****(3E3X1-15.3.4.)**

<b>Question</b>	<b>Answer</b>
1. Batter boards are used on _____.	b. Large slabs
2. What is the standard length for steel forms?	b. 10 feet
3. What is the standard length for wood forms?	c. There is no standard length for wood forms
4. What type of lumber should be used for creating a curve on a driveway?	c. 1" x 4" x 8'
5. What type of slab is poured in one continuous pour?	b. Monolithic

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### Install Forms

**(3E3X1-15.5.)**

Question	Answer
1. Why do you want to remove any grass and under bush prior to pouring a new pad?	c. The grass will create a void in the concrete
2. What is the determining factor of installing forms with the use of batter boards or grade stakes?	b. Size of the new pad
3. What instrument can be used to assist the Engineer technician in setting batter boards?	c. Transit
4. When first starting to form for a pad, what corner should you start in to get your baseline?	a. Start with the highest corner
5. What type of nails should you use for installing forms?	d. Duplex

### Place Concrete in Forms

**(3E3X1-15.9.)**

Question	Answer
1. What should be accomplished prior to the concrete being placed into the form?	d. All of the above
2. Why do you NOT want to work concrete over long distances?	a. To do so will cause segregation
3. Concrete for walls should be place in _____ layers of uniform thickness not exceeding 6 to 12 inches.	c. Horizontal
4. What can be placed down prior to the mesh or rebar to keep the ground from absorbing all the water out of the concrete?	a. 15-mil plastic
5. What sort of tool(s) can be used to consolidate the concrete to provide a smooth surface?	d. Both a. and c.

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**Finish Concrete**

**(3E3X1-15.12.)**

<b>Question</b>	<b>Answer</b>
1. What is the first step in finishing the concrete after it has been placed?	c. Screeding to a level elevation
2. What does the step “floating” do to the concrete?	a. Embeds the aggregate beneath the surface
3. When should the edging of the concrete take place?	d. Both a. and b.
4. What is used to get a machine finish on the concrete?	a. Power trowel
5. What can be used to cover the concrete to assist in the curing process?	d. All of the above

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